AIRCRAFT CIRCULARS

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

No. 83

THE VICKERS "VELLORE" (BRITISH)

Freight Carrier

Washington
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THE VICKERS "VELLORE" (BRITISH). *

A Freight Carrier

Which Carries a Load Greater than Its Own Weight.

In many ways one of the most intersting aircraft produced in recent times, the "Vellore," designed and built by Vickers, Ltd., of Weybridge, Surrey, for Imperial Airways, Ltd., is a single-engined biplane of all-metal construction intended to carry freight and goods, a form of air traffic which has been becoming steadily more popular, and which promises to assume large proportions. Hitherto there has been no airplane available designed specifically for this particular kind of work, with the result that freight and goods have had to be carried in airplanes not really suitable for the work. In the "Vellore," however, Mr. R. K. Pierson has produced an airplane in which high pay load per horsepower was the main object, coupled always with a reasonably good performance.

It is now a well-established fact that in order to keep down induced drag at low speeds it is necessary to have a high value of the ratio $\frac{\text{Span}^2}{\text{Weight}}$ and in the "Vellore" the span has been kept very large, 76 feet, to be exact, so that the induced drag at take-off speed and at the low speed at which the airplane

*From Flight, September 6, 1928.

climbs is very small.

As the "Vellore" weighs 9,500 pounds fully loaded, the value of $\frac{\text{Span}^2}{\text{Weight}} = 0.608$, which is very high for a commercial airplane. If it is assumed that the airplane climbs at an air speed of 60 M.P.H., and as the ratio of gap to span is 0.132, the ratio of lift to induced drag corrected for the particular biplane arrangement employed is as high as 22.13 at the speed of 60 M.P.H. In other words, at that speed the induced drag is 430 lb. only, corresponding to a thrust horsepower of 68.8, a figure which gives a good idea of the efficiency of the biplane wing arrangement of the "Vellore."

An examination of Figures 1, 2, and 3, will show that in this large biplane cellule, the fuselage itself, although of considerable actual dimensions, forms a fairly small percentage of frontal area, and the form is good also, with but few excrescences, so that one may assume that the total drag of the airplane is low. This is borne out by the "Everling Quantities" given at the end of this circular, from which it will be seen that the "High-speed figure" is as high as 24.65, a value which indicates a very small minimum drag. One may, therefore, accept it that the aerodynamic efficiency of the "Vellore" design is very good. That the structural efficiency is also above normal is shown by the fact that the load carried is 51.6 per cent of the total loaded weight. In other words, the airplane carries a load greater than its

weight. The actual figures are: empty weight, 4,550 lb.; load carried, 4,950 lb.; total loaded weight, 9,500 lb. These figures indicate that the methods of metal construction employed by Vickers are very economical, and as duralumin is the material employed throughout, with a few unimportant exceptions, advocates of this material for aircraft structures will find in the "Vellore" a very good proof of their contentions.

Constructional Features

The fuselage of the "Vellore" is of duralumin construction. It is built in two distinct portions, of which the front section is built up in the form of a metal semi-monocoque. Doubtless this has been done in order to leave the luggage "hold" as free of internal bracing as possible. The rear portion of the fuselage is a girder, in which longerons and struts are circular-section duralumin tubes, braced by tie rods. Figure 8 shows the attachment of a longeron to the monocoque front portion, and incidentally a good deal of the detail construction of both fuselage portions.

The front portion of the fuselage has two deep longerons at the bottom, built up of angle sections and corrugated walls, while the top longerons are quite light angle sections (Fig. 5). The members corresponding to struts in a girder type of construction are in the form of box-section members formed from angle sections, T-sections, and corrugated strip, in the manner shown

in Figures 4, 5 and 8. The covering is duralumin sheet, longitudinally corrugated for stiffness so as to support part of the loads as a stress-bearing member. The luggage "hold" is of large dimensions and entirely without bracing members internally, so that should occasion arise, the whole of it could be used for bulky goods (Fig. 5).

A hinged trap door in the floor of the rear portion of the fuselage gives access to the "hold" and hoisting tackle is provided inside the latter for lifting freight into the airplane and drawing it along the floor, which is in the form of corrugated duralumin sheet, very substantial and stiff (Fig. 9).

The pilot's cockpit is in front of the freight hold, separated from it by a wall, the communicating door being on the starboard side (Fig. 5). The pilot's seat is on the port side, behind and above the engine, and provision is made for raising and lowering the seat. In the raised position of the seat the view is remarkably good, as the pilot is then well above the engine. A short ladder of duralumin tubing runs from the cockpit floor to the seat, and if an engineer, navigator or spare pilot is carried, this ladder folds down and forms a seat for him.

The "Vellore" is equipped with every conceivable aid to navigation, such as a turn indicator in addition to the usual instruments; wireless transmitting and receiving apparatus; night-flying equipment, and so on. In fact, for a freight carrier, the "Vellore" appears needlessly encumbered with "gadgets," but

doubtless these were demanded by Imperial Airways in order that the airplane might be tried out under all manner of conditions.

The engine fitted is a Bristol "Jupiter IX," which is, of course, a geared engine, the increased propeller efficiency due to the 2 to 1 gearing being particularly desirable in an airplane like the "Vellore," which carries a large load per horsepower at a relatively low forward speed. The gasoline tanks, with a total capacity of 162 gallons, are placed in the top wing, so that direct gravity feed is employed.

Like the fuselage the wings are of all-metal construction (Fig. 6) with exception of the covering which is fabric. The special form of wing spar construction developed by Vickers has already been described in detail in Flight, so that it will suffice if we recall that the feature of the spar is the "wandering web," which crosses over from front to back of spar every few inches, leaving every rivet readily accessible. This "wandering web" fits into channel section flanges at top and bottom. The ribs are also duralumin channels, and in place of tubular drag struts stronger ribs are used, some of these being extended aft of the rear spar to form supports for the Bristol-Frise ailerons (Fig. 7). The interplane struts are of heavy gauge duralumin, each strut being made in two halves, the joints being along the front and rear edges of the strut, where the rows of rivets occur. In Figures 2 and 3, included herewith, the wing tip skids are in the form of hoops. These have now been replaced by straight

sprung skids of a form not unlike tail skids, and similarly sprung (Fig. 1). This was deemed advisable in view of the low wing loading of the "Vellore," which renders the airplane somewhat liable to be blown on to a wing tip when on the ground. The tail of the "Vellore" is of the biplane type found on so many Vickers airplanes. It is also unusual in that no less than four rudders are used, but it will be observed that there are no fixed vertical tail surfaces. The rudders are balanced, and with the total area split up into four relatively small ones, the loads on the rudder control pedals are very light. The tail skid shoe has a castor action, which makes the airplane easy to steer on the ground.

The landing gear of the "Vellore" is of the oleo-pneumatic type, with a long travel, and the track is fairly wide in actual dimensions, although relatively small for the large wing span, hence the special wing tip skids to which reference has been made.

S p e c i f i c a t i o n

The main dimensions, areas, etc., are shown on the general arrangement drawings (Fig. 1), but some of them are repeated in the following specification for the sake of convenience.

Engine	Bristol "Jupiter IX"
Maximum horsepower	525 B.HP. at 2000 R.P.M.
Propeller drive	Geared 2 : 1
Fuel capacity	162 gallons (730 liters)

Main Dimensions

Wing span (top and bottom)	76 ft. 0 in. (23.470 m)
Wing chord (top and bottom)	9 " 6 " (2.895 ")
Total wing area (including ailerons)	1,416 sq.ft. (132 m²)
Ailerons	195 "
Stabilizer	70 "
Elevators	35.5 "
Rudders	44.5 "
Length, over-all	51 ft. 6 in. (15.695 m)
Height " "	16 " 9 " (5.106 ")
Width, folded	20 " 9 " (6.325 ")

Weights and Loading

Weight, empty	4,550 lb. (2,064 kg)
Load carried	4,950 " (2,245 ")
Total loaded weight	9,500 " (4,309 ")
Wing loading	6.7 lb./sq.ft. (32.71 kg/m²)
Power loading (on 525 HP.)	18.1 lb./HP. (8.21 kg/HP)

Performance

Speed at ground level	110 mi./hr. (177 km/h)
" " 5,000 ft. (1,525 m)	106 " (171 ")
" " 10,000 " (3,050 ")	101 " (163 ")
Landing speed	50 " (80 ")

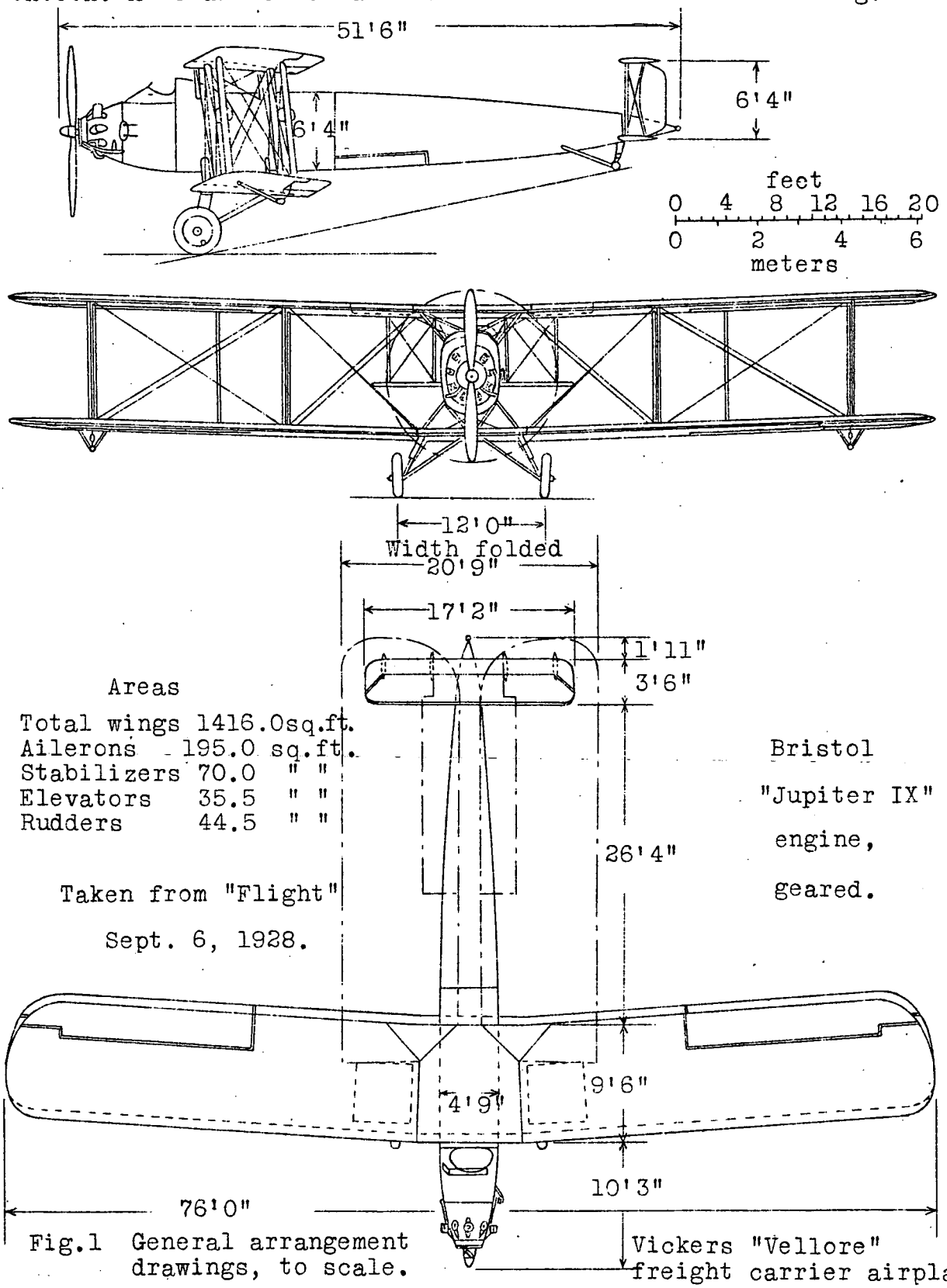
Performance (Cont.)

Climb to 5,000 ft. (1,525 m)	in 10.5 min.
" " 10,000 " (3,050 ")	" 29 "
Service ceiling	12,000 ft. (3,660 m)
Absolute "	14,700 " (4,480 ")
Range at full throttle	750 mi. (1,210 km)

Everling Quantities

High-speed figure	24.65
Distance "	5.3
Altitude "	5.8

Both the actual performance figures and the "Everling Quantities" indicate that the "Vellore" is an unusually efficient design, and it will be interesting to see how it performs when put into practical use by Imperial Airways.



Areas

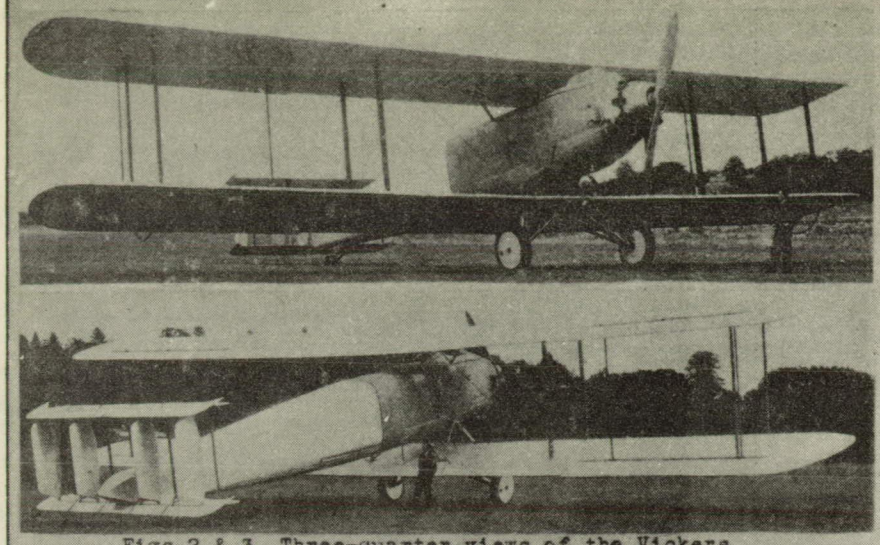
Total wings 1416.0sq.ft.
Ailerons 195.0 sq.ft.
Stabilizers 70.0 " "
Elevators 35.5 " "
Rudders 44.5 " "

Taken from "Flight"

Sept. 6, 1928.

Bristol "Jupiter IX" engine, geared.

Fig.1 General arrangement drawings, to scale. Vickers "Vellore" freight carrier airplane



Figs.2 & 3 Three-quarter views of the Vickers "Vellore" freight-carrier airplane.

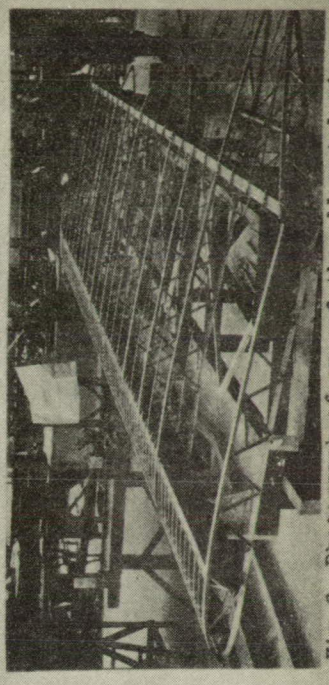


Fig.6 Photograph of one of the all-metal wings.

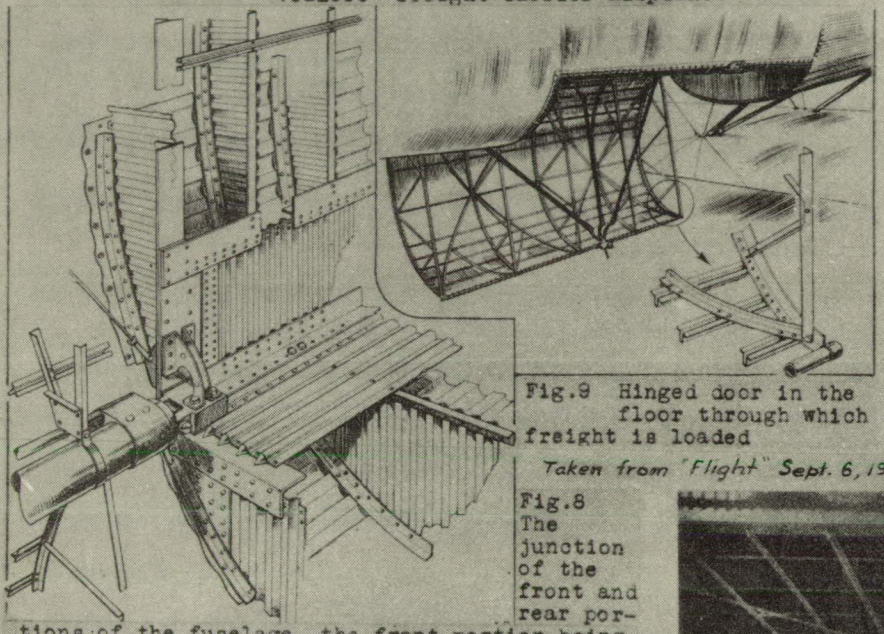


Fig.8 The junction of the front and rear portions of the fuselage, the front portion being built up of sheet duralumin, while the rear is a duralumin tube girder. Note the construction of the freight hold floor.

Fig.9 Hinged door in the floor through which freight is loaded

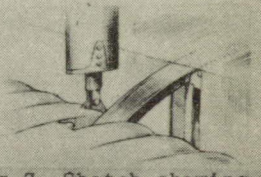


Fig.7 Sketch showing the type of duralumin rib used instead of drag struts. This rib also carries the Bristol-Frise aileron hinge.

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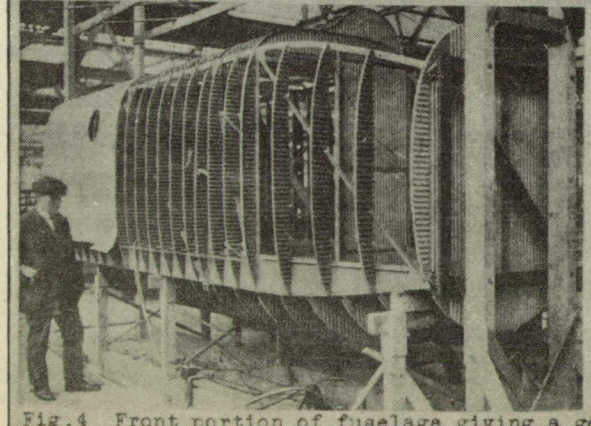

Fig.4 Front portion of fuselage giving a good idea of the metal construction employed.

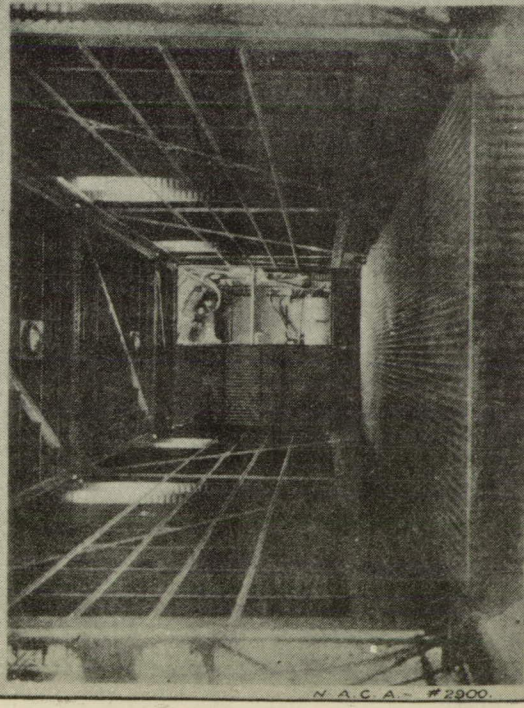

Fig.5 A view inside the freight hold looking toward the pilot's cockpit.

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